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Performance related pay and labor productivity

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Abstract

This paper uses information from a panel of Dutch firms to investigate the labor productivity effects of performance related pay (PRP). We find that PRP increases labor productivity at the firm level with about 9%.

Keywords: performance related pay, labor productivity

JEL-codes: C41, H55, J64, J65

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1 Introduction

Over the past decade in the Netherlands the use of performance-related pay (PRP) has increased substantially (Table 1). Whereas in 1995 30% of the firms used PRP, this was 39% in 2001. The increased popularity of PRP-schemes may be due to the increase in labor productivity caused by the schemes. PRP may stimulate labor productivity for two reasons. First, in situations of asymmetric information about worker's abilities or effort a PRP-scheme can be used to induce workers to exert the right amount of effort (see for example Prendergast (1999) and Lazear (2004)). Second, when hiring new workers, piece rates can be used as a screening mechanism to encourage only the most able workers to apply (Lazear, 1986).

PRP-schemes can be either individual performance pay schemes, such as piece rate wages, or collective performance pay schemes, such as profit sharing. In case of teamwork individual performance is difficult to measure, hence there is an incentive to free-ride. In such a case, group-based incentive schemes may have little effect on individual productivity. Additionally, perverse incentives may arise in case of multitasking. When employees are required to perform several tasks, they will focus only on those activities being rewarded and neglecting other activities. Therefore it is not always clear that PRP-schemes indeed increase productivity. Nevertheless, recent empirical studies do find evidence in support of PRP increasing productivity, although the size of the effect differs substantially. Whereas Cahuc and Dormont (1997) for example find a mild increase in productivity due to profit sharing arrangements of about 2% for French firms, Lazear (2000) finds that piece rates cause productivity to increase with about 40% for U.S. firms, half of which is due

to an increase of the productivity of the incumbent workforce ("incentive") and half of which is due to the inflow of high-productivity workers ("sorting").[1]

The increased popularity of PRP-schemes in the Netherlands is not caused by evidence about productivity effects. As far as we know this is the first paper that presents an analysis of the PRP-productivity effects in Dutch firms. We investigate the determinants of the use of PRP-schemes but our focus is on the productivity gain of firms that adopt PRP-schemes (or productivity losses of firms which abolish PRP-schemes). In our analysis we account for potential selectivity of PRP-adoption, i.e. the case in which more profitable firms are more likely to introduce performance related pay. Our results indicate that PRP indeed increases productivity substantially.

2 Data

The OSA Labor Demand Panel is a biennial longitudinal panel survey among establishments with at least 5 employees.[2] The data we use are from four consecutive waves and cover the period 1995-2001. In our data 794 establishments are observed twice, 288 three times, 84 four times, which gives us a sample of 1166 firms with 2788 observations. The dataset comprises all industries, but the sample is stratified with respect to the area of economic activity and firm size.[3]

[1]The empirical literature shows that generally profit sharing arrangement have smaller productivity effects than piece rate schemes. This may have to do with piece rate schemes being applicable only in situations in which individual output can be monitored and free-riding is not an issue.

[2]In this paper we will use the terms *establishment* and *firm* interchangeably to describe the unit of analysis.

[3]As the OSA panel is a stratified sample with unequal sampling rates, sampling weights are applied to obtain figures that are representative for Dutch establishments with 5 or more employees.

For each wave of the panel we know whether or not a PRP scheme is active. Additionally, the dataset contains information on sales and production costs, which allows the construction of a measure of per capita value added for each establishment.

3 Parameter estimates

3.1 Determinants of PRP

Table 1 provides some stylized facts on the presence of PRP. As shown especially larger firms have increased the use of PRP-schemes. Whereas in 1995 29% of the firms with more than 100 employees had a PRP-scheme, this increased to 53% in 2001. Although there is quite some variation in the use of PRP-schemes according to the size of the firm, there is even more variation across industry. Whereas in health care and education only about 10% of the establishments had a PRP-scheme this is about 55% in construction.

Estimates on the presence of PRP in firms using our data as a pooled cross section indicate that PRP schemes are more likely to be adopted in large firms and in the construction sector.[4] In industries where output is difficult to measure, e.g. health care sector, PRP schemes are less likely to be adopted. Furthermore, during the late 1990s the use of PRP schemes has increased.

To correct for potential selection effects, a logit model is estimated accounting for firm fixed effects: $\Pr(r_{it} = 1) = \Lambda(\alpha_i + \beta x_{it})$ and $\Pr(r_{it} = 0) = \Lambda(-\alpha_i - \beta x_{it})$, where r indicates whether or not a firm has a PRP scheme, x is a vector

[4]These estimates using a binomial logit model are not presented, but are available on request. In the pooled cross-section estimates we also find that PRP schemes are more likely to be present in firms with a high share of employees covered by a collective agreement and in firms with a high share of white collar workers.

of explanatory variables including firm size and calendar year, Λ is an indicator of the logistic cumulative distribution function, i refers to firm, t refers to the year (1995,..., 2001) and the α_i represent firm fixed effects. Because of the fixed effects many firms characteristics – all non time-varying characteristics – are accounted for. The parameters are estimated using Chamberlain's conditional likelihood method. This means that the parameters are identified on the subset of observations for which the dependent variable changes at least once over time.

The parameter estimates are presented in Table 2. The results indicate that the effect of firm size is insignificant. Apparently, the firm size effect is more a cross-sectional phenomenon than a direct causal effect. There is a clear increase in the use of PRP over time.

3.2 Labor productivity effects of PRP

In this section we determine the effect of PRP on labor productivity. Labor productivity is calculated as follows: $y_{it} = s_{it} * (1 - m_{it})/n_{it}$, where s represents sales (denoted in 1995 Dutch guilders), m the percentage of costs in sales, and n the number of employees of the firm. As the dependent variable we use the natural logarithm of y_{it} and as explanatory variables we have the presence of PRP, firm size and calendar year. In the analysis we include firm fixed effects to control for selectivity in the use of PRP schemes. The parameter estimates are presented in the second column of Table 2. It appears that PRP schemes increase productivity with 9.0%. Furthermore, firm size has a negative effect on productivity[5], while firms become more productive over time.

[5]The negative effect of firm size in the panel analysis is most likely a short term effect. If firms expand their workforce in the short run productivity goes down.

We performed a number of sensitivity analyzes to investigate the robustness of the PRP productivity effect. We started with ignoring the firm fixed effects and did a pooled cross-section analysis, as if we have no panel data. If no panel data are available it is impossible to distinguish between the incentive effects of PRP and spurious correlation between PRP and productivity that will typically arise if more productive firms are more likely to adopt a PRP scheme. As a result of this potential endogeneity of the PRP variable the estimated effect of PRP would be biased upwards. Indeed, as shown in Table 3, in the pooled cross-section the PRP-productivity effect is estimated as 12.4%.[6] We also estimated a model in which the firm specific effects were included as random effects. This specification implicitly assumes that PRP can be treated as an exogenous variable in the sense that PRP-adoption is not related to firm-specific characteristics that are related to higher productivity. As in the pooled regression, the effect of PRP will be overestimated if PRP-adoption is subject to endogenous selection. This expectation is confirmed. Testing the fixed effects specification against the random effects specification, we find that the fixed effects model is to be preferred.[7]

Furthermore, we noticed that there was a lot of variation in the reported sales figures indicating potential measurement errors. In order to reduce measurement errors we excluded observations with a large change in sales between two panel observations. We used an indicator variable z defined as $z_{it} = ln(s_{it}) - ln(\overline{s_i})$ where $\overline{s_i}$ is the average sales of firm i over the time period available. First, we remove

[6] In these estimates we find that large firms are more productive than small firms. Apparently in the long run productivity are positively correlated with the size of the workforce.

[7] The Hausman test of the random effects specification against the fixed effects specification is 100.95. This is a χ^2-test with 5 degrees of freedom and firmly rejects the random effects specification indicating that the firm specific effects are correlated with the PRP variable.

observations for which $|z_{it}| > 1$. This reduces the sample size but does not affect the productivity effect of PRP in the fixed effects specification. Applying a more strict criterion of removing observations for which $|z_{it}| > 0.5$ does not change the results either.

Finally, we re-estimated the model correcting for the average number of working hours in the firm. Hence, we used an indicator of productivity per hour worked. This leads to less accurate estimates for two reasons. First, the information on the working hours is available only for a limited number of firms. Second, the average number of hours is rather imprecise as it is measured in categories. As shown, now the PRP-parameter is estimated with less precision but, as shown in the bottom line of Table 3, still significantly different from zero at 10%.

All in all, we conclude from our sensitivity analysis that the estimated productivity effect of PRP of 9% is quite robust.

4 Conclusions

This paper presents an analysis of the productivity effects of PRP at the firm level. We find that the introduction of PRP increases labor productivity with about 9%. To the extent that firms are aware of this it is clear why firms increasingly adopt PRP schemes. Our results are quite robust. The fixed effects approach proves to be useful for modeling the causal effect of PRP on productivity. To substantiate the estimated effect it would be worth applying the model to data that contain more detailed information about the types of PRP-schemes and the characteristics of workers involved, information that may be available from linked employer-employee data.

References

[1] Cahuc, P. and B. Dormont (1997), Profit sharing: Does it Increase Productivity and Employment? A Theoretical Model and Empirical Evidence on French Micro Data, *Labour Economics*, 4, 293-319.

[2] Lazear, E.P. (1986), Salaries and Piece Rates, *Journal of Business*, 59, 405-431.

[3] Lazear, E.P. (2000), Performance Pay and Productivity, *American Economic Review*, 90, 5, 1346-1361.

[4] Lazear, E.P. (2004), Output-Based Pay: Incentives, Retention or Sorting, in: S.W. Polachek (ed.), *Research in Labor Economics*, JAI Press, Stanford, 1-25.

[5] Prendergast, C. (1999), The Provision of Incentives in Firms, *Journal of Economic Literature*, 37, 7-63.

Table 1: Presence of performance related pay in Dutch firms (%)

	1995	**1997**	**1999**	**2001**	**No. of firms**
Total	30	35	40	39	2788
By firm size					
<25	32	36	40	35	1037
25–50	29	36	33	49	376
51–100	21	31	46	48	399
>100	29	29	40	53	976
By industry					
Manufacturing, agriculture	30	34	38	45	738
Construction	44	56	56	55	308
Trade	36	36	45	41	255
Transportation	16	14	20	39	83
Financial services	31	42	44	36	242
Health care	13	6	7	10	594
Other services	21	29	25	35	137
Government	47	48	40	38	225
Education	14	8	13	9	206
No. of firms	763	932	724	369	2788

Source: OSA Labor Demand Survey. Sampling weights are used to create numbers that are representative for firm establishments with at least 5 workers.

Table 2: Parameter estimates

	Presence of PRP	**Labor productivity**
PRP	–	0.090 (0.042)**
ln(firm size)	0.397 (0.266)	−0.881 (0.048)**
1997	0.128 (0.144)	0.130 (0.031)**
1999	0.521 (0.181)**	0.164 (0.037)**
2001	0.688 (0.225)**	0.160 (0.048)**
Observations	895	2788
Firms	356	1166

Note: Presence of PRP: logit model; Labor productivity: linear regression; all estimates contain firm fixed effects; standard errors in parentheses, a ** indicates that the coefficient is different from zero at a 5% level of significance; reference year is 1995.

Table 3: Sensitivity analysis

	PRP parameter	**No. of observations**
Baseline estimate	0.090(0.042)**	2788
Pooled cross-section	0.124(0.044)**	2788
Random Effects	0.178(0.039)**	2788
No outliers ($\|z_{it}\| < 1$)	0.089(0.041)**	2775
No outliers ($\|z_{it}\| < 0.5$)	0.091(0.039)**	2665
Hourly productivity	0.156(0.088)*	1320

Note: The baseline estimate is similar to the one presented in Table 2; standard errors in parentheses, a ** (*) indicates that the coefficient is different from zero at a 5% (10%) level of significance.